Name KEY

NUCLEAR CHEMISTRY REVIEW SHEET

Answer the following questions on this sheet or in your composition notebook:

Isotopes/Atomic Structure Review

1. What particles make up the nucleus of an atom? PROTONS & NEUTRONS
2. What does the atomic number of an atom represent? # OF PROTONS
3. What does the mass number of atom represent? # OF PROTONS + # OF NEUTRONS
4. What is an isotope? ATOM OF THE SAME TYPE (ELEMENT) W/ DIFFERENT # OF NEUTRONS
5. Calculate the number of neutrons in Iodine – 131. 78 — $^{131}_{53}$ / 78
6. Write the isotopic formula for Iodine – 131. $^{131}_{78}I$

Stability and Nuclear Forces

7. In a **chemical** reaction, how do atoms achieve stability? LOSE/GAIN/SHARE e^-
8. In a **nuclear** reaction, how do atoms achieve stability? GO THROUGH RADIOACTIVE DECAY
9. What two forces are present in the nucleus of an atom? STRONG NUCLEAR FORCE & ELECTROSTATIC FORCES
10. What force causes two protons to repel? ELECTROSTATIC FORCES
11. If protons naturally repel each other, what particle acts like the "glue" that holds the nucleus together? NEUTRONS
12. The strong nuclear force is an attraction between NEUTRONS and PROTONS.
13. At short distances, the strong nuclear force is VERY STRONG, but at long distances, the strong nuclear force NON-EXISTENT.
14. At the short distances, the electrostatic force is STRONG and at long distances it is WEAK.
15. Stable nuclei have a ratio of protons to neutrons of 1 : 1.
16. As nuclei get larger, it takes more NEUTRONS to stabilize the repulsion of the protons.
17. There are no stable atoms with an atomic number greater than 83.
18. When a nucleus becomes too large, the NUCLEAR FORCE force disappears. The ELECTROSTATIC force is still present, so the protons repel and emit parts of the nucleus called RADIOACTIVE PARTICLES
19. Fill in the following chart for the two forces that hold an atom together.

Characteristic	Strong Nuclear Force	Electrostatic Force
Acts between ...	P + N	P + P P + E
Attractive or repelling force?	ATTRACT	REPEL ATTRACT
Strength at long distances	VERY STRONG	WEAK
Strength at short distances	NON EXISTANT	STRONG

Radioactivity

20. All nuclei with an atomic number greater than 83 are said to be unstable, or RADIOACTIVE
21. What is radiation? THE PARTICLES RELEASED FROM THE NUCLEUS DURING RADIOACTIVE DECAY
22. What is radioactive decay? A NUCLEUS UNDERGOING CHANGE TO BECOME STABLE
23. What are the three types of radioactive decay? ALPHA & BETA & GAMMA
24. What type of radiation can be stopped by aluminum foil? _____
25. What type of radiation is essentially just the release of energy? GAMMA
26. What type of radiation is the most massive? ALPHA
27. What is the charge of an alpha particle? +2
28. What is the charge of a beta particle? -1
29. What type of radiation can be stopped by paper? ALPHA
30. Describe the particles that make up an alpha particle. 2P 2N
31. A beta particle is released when a NEUTRON decays into a PROTON and a ELECTRON
32. How does beta radiation affect atomic mass? STAYS SAME Atomic number? ↑ (+1)
33. How does alpha radiation affect atomic mass? ↓ (-4) Atomic number? ↓ (-2)
34. How does gamma radiation affect atomic mass? STAYS SAME Atomic number? STAYS SAME
35. How many alpha particles are released for the complete decay of Uranium – 238 to Lead – 218? 5
36. How many beta particles are released from the decay of Iodine – 131 to Xenon – 131? 1
37. Three types of radioactive emissions are called alpha (a), beta (b) and gamma (g) radiation. Complete the table below with the correct information about each type.

	What is it?	Symbol	Can Be Stopped By	Penetrating Power
Alpha	HELIUM NUCLEI $^{4}_{2}He$	α	PAPER	↓ LOW
Beta	$n \rightarrow p$ AND e- $^{0}_{-1}e$	β	FOIL	MEDIUM
Gamma	HIGH NRG (NO MATTER)	γ	LEAD/CONCRETE	↑ HIGH

38. Which of the three radioactive emissions (a, b, g) best fit the following statements? Write the correct symbol/s on the lines.
    a. These emissions are charged (more than one). a/b
    b. This emission is the most massive (heaviest). a
    c. This emission is the most charged. a
    d. This emission is most dangerous outside of the body. g
    e. This emission is stopped by thin paper or a few centimeters of air. a
    f. This emission can travel through paper, but is stopped by aluminum. a/b
    g. This emission can travel through fairly thick lead. g
39. Which type of radiation – alpha, beta, or gamma:
    a. Results in the greatest change in atomic number? Why?
    $\alpha \rightarrow$ ↓ atomic # by 2
    b. Results in the least change in atomic number? Why?
    $\gamma \rightarrow$ no change in atomic #

c. Produces the greatest change in mass number? Why?

α ↑ mass by 4

d. Produces the least change in mass number? Why?

γ – no change in mass

40. Alpha radiation is emitted during the disintegration of the following isotopes. Write balanced nuclear equations for their decay processes.

a. uranium-238 $^{238}_{92}U \rightarrow {}^{4}_{2}He + {}^{234}_{90}Th$

b. uranium-240 $^{240}_{92}U \rightarrow {}^{4}_{2}He + {}^{236}_{90}Th$

c. polonium-218 $^{218}_{84} \rightarrow {}^{4}_{2}He + {}^{214}_{82}Pb$

d. polonium-216 $^{216}_{84} \rightarrow {}^{4}_{2}He + {}^{212}_{82}Pb$

41. The following radioisotopes are beta emitters. Write balanced nuclear equation for their decay processes.

a. carbon-14 $^{14}_{6}C \rightarrow {}^{0}_{-1}e + {}^{14}_{7}N$

b. nickel-63 $^{63}_{28}Ni \rightarrow {}^{0}_{-1}e + {}^{63}_{29}Cu$

c. nickel-64 $^{64}_{28}Ni \rightarrow {}^{0}_{-1}e + {}^{64}_{29}Cu$

42. Complete the following nuclear reactions by re-writing and filling in the missing blanks:

a. $^{226}_{88}Ra \rightarrow {}^{?}_{?}? + {}^{0}_{-1}e$ $^{226}_{88}Ra \rightarrow {}^{226}_{89}Ac + {}^{0}_{-1}e$

b. $^{209}_{84}Po \rightarrow {}^{205}_{82}Pb + {}^{?}_{?}?$ $^{209}_{84}Po \rightarrow {}^{205}_{82}Pb + {}^{4}_{2}He$

c. $^{238}_{92}U \rightarrow {}^{?}_{?}? + {}^{4}_{2}He$ $^{238}_{92}U \rightarrow {}^{234}_{90}Th + {}^{4}_{2}He$

43. When isotope bismuth-213 emits an alpha particle:

a. Write out the nuclear equation:

$^{213}_{83}Bi \rightarrow {}^{209}_{81}Tl + {}^{4}_{2}He$

b. What new element results if the isotope, emits a beta particle instead?

$^{213}_{83}Bi \rightarrow {}^{0}_{-1}e + {}^{213}_{84}Po$

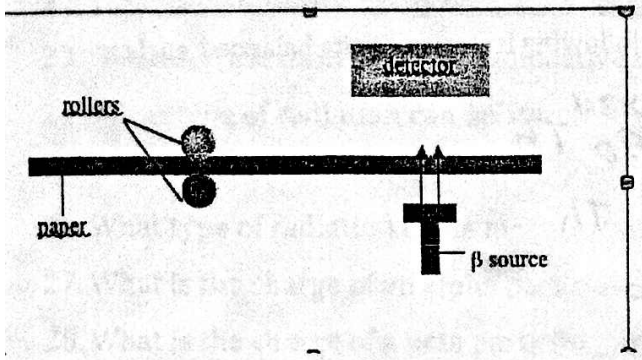
44. When $^{218}_{84}Po$ emits a beta particle, it transforms into a new element.

a. Write out the nuclear equation: $^{218}_{84}Po \rightarrow {}^{0}_{-1}e + {}^{218}_{85}At$

b. Fill out the chart below:

	Name of the Element	Atomic Number	Mass	# Protons	# Electrons	# Neutrons
Parent Element (reactant)	POLONIUM	84	218	84	84	134
Daughter Element (product)	ASTATINE	85	218	85	85	133

45. In a papermaking factory, beta radiation is used to check that the paper being produced is the correct thickness. If the paper gets too thin, the reading on the detector increases causing the rollers to move apart to make the paper thicker. If the paper gets too thick, the reading on the detector goes down causing the rollers to move closer together. A diagram of this set-up is shown below:



Explain why beta radiation is used for this procedure rather than alpha or gamma radiation.

PAPER CAN STOP α RADIATION

4 - TOO DANGEROUS / UNNESSESSARY

Half-life and Radioactive Decay Rates -

46. What is half-life? THE AMT OF TIME IT TAKES FOR $\frac{1}{2}$ A SUBSTANCE TO DECAY

47. You have 1000 g of Iodine-131. How much iodine is left after 1 half-life? After 2 half-lives? After 3 half-lives?

500g | 250g | 125g

48. Carbon 14 has a half-life of 5,730 years. If a sample contains 100g originally, how much is left after 17,190 years?

$5{,}730\overline{)17{,}190}$ → 3

$\frac{100}{2} = \frac{50}{2} = \frac{25}{2} = 12.5\text{g}$

1 2 3

49. If 100 g of Au-198 decays to 6.25 g 40 days, what is the half-life of Au-198?

100 → 6.25

4 H.L.

$4\overline{)40}$ → 10

10 days

Nuclear Reactions

50. What is a transmutation? PROCESS OF CHANGING ELEMENT TO ANOTHER THROUGH DECAY

51. Is more energy released in a chemical or nuclear reaction? NUCLEAR

52. Describe the process of nuclear fission. WHEN NEUTRON BOMBARDING A RADIOACTIVE ELEMENT CAUSING IT TO UNDERGO DECAY - RELEASING NEUTRONS - CHAIN RX

53. Describe the process of nuclear fusion. 2 HYDROGEN ISOTOPES COMING TOGETHER TO FORM HELIUM RELEASE OF A NEUTRON + TONS OF NRG

54. Describe what happens during a nuclear chain reaction.

NEUTRONS RELEASED HIT OTHER NUCLEI AND CAUSE THEIR DECAY - PRODUCING MORE NEUTRONS WHICH CONTINUE THE CYCLE

55. What must be sustained in order for a nuclear chain reaction to occur? CRITICAL MASS

56. What nuclear reaction fuels the sun? FUSION

57. Which nuclear reaction results in the greatest amount of energy released, fission or fusion? FUSION

Radiation Today

58. List 3 sources of background radiation. SUN & ROCKS & PLANTS

59. What are the units for measuring the amount of radiation exposure? REMS
MILLIREMS